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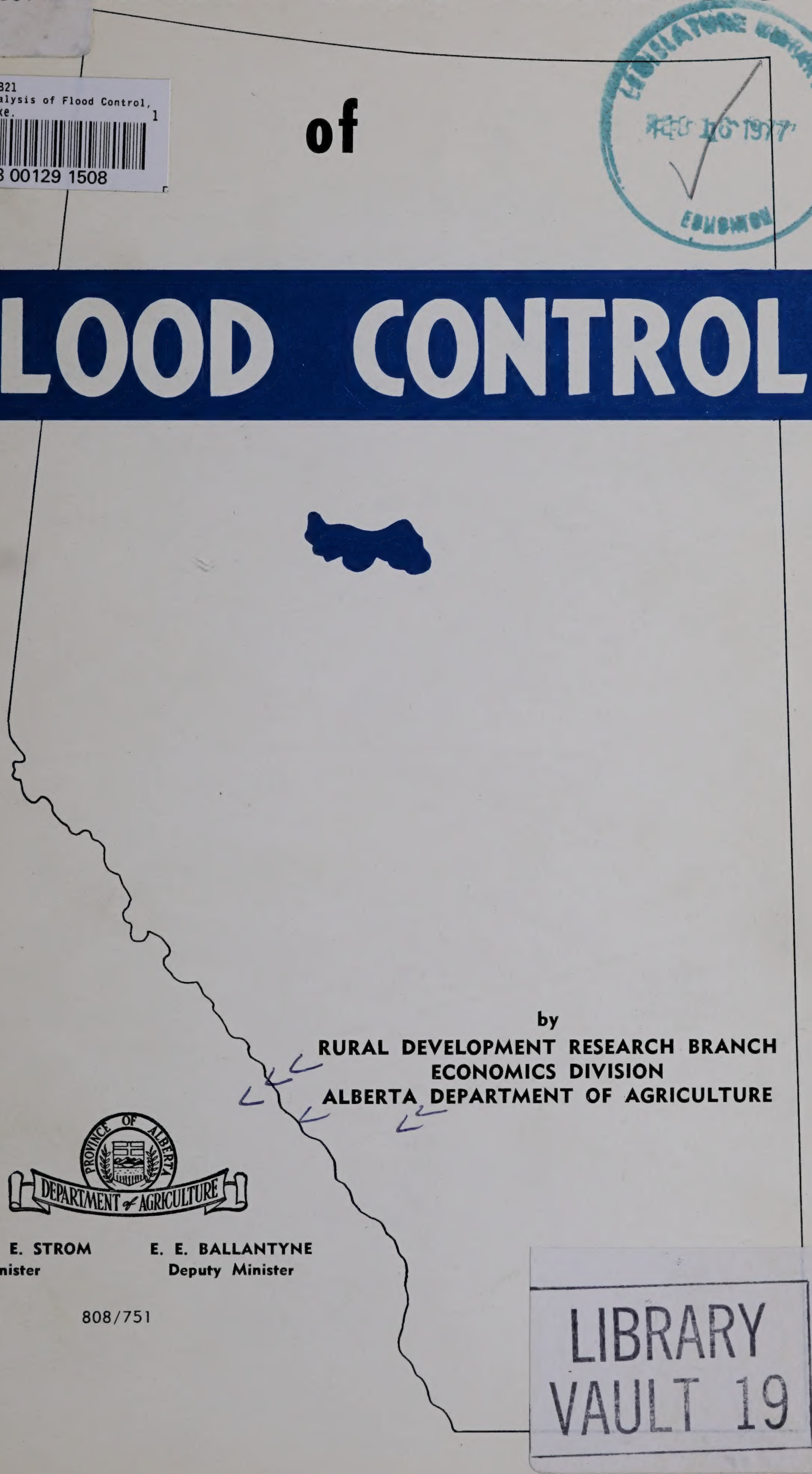
A BENEFIT-COST ANALYSIS

of

FLOOD CONTROL

LESSER SLAVE LAKE



by
RURAL DEVELOPMENT RESEARCH BRANCH
ECONOMICS DIVISION
ALBERTA DEPARTMENT OF AGRICULTURE

HON. H. E. STROM
Minister

E. E. BALLANTYNE
Deputy Minister

808/751

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BENEFIT-COST ANALYSIS
of
FLOOD CONTROL
LESSER SLAVE LAKE

PUBLISHED BY

THE RURAL DEVELOPMENT RESEARCH BRANCH
OF
THE ECONOMICS DIVISION

ALBERTA DEPARTMENT OF AGRICULTURE

VICTOR T. JANSSEN
SUPERVISOR

FEBRUARY 1967

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PREFACE

Water, often referred to as the staff of life, has many values. It is essential for all animal and vegetable growth and is required in most industrial processes.

However, water can be an extremely destructive force introducing instability into the economy of an area by flooding agricultural land and destroying buildings and other assets.

Flooding or the threat of flooding has been a problem to the residents of the Lesser Slave Lake region since the area was first settled. Rivers frequently overflow their banks, level land remains saturated after periods of heavy precipitation and the lake level fluctuates, flooding as much as fifty thousand acres at high water level. It also caused damage to roads and railroads and was instrumental in the relocation of towns.

In order to obtain more information on the problem of flooding from the lake, a study, primarily designed to determine the feasibility of lowering the level of Lesser Slave Lake, was undertaken in 1966 under the supervision of Vic Janssen. The investigation was limited by the original terms of reference, to the area flooded by the lake. The cost of the study was shared equally by the Federal and Provincial Governments under the Area Rehabilitation and Development Act.

It is hoped that this publication will provide background information which will serve as an economic basis for decisions and actions by various government agencies and the local people to formulate programs to, at least, partially alleviate the hardships resulting from rising levels of the lake.

GLEN R. PURNELL, Director
Economics Division

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Many people contributed to this study by supplying information and by analyzing and preparing the data. Appreciation is extended to the local people for their co-operation during the interviews. Special thanks is extended to Mr. Leo Regehr for his assistance in compiling the data and drafting the study.

Appreciation for helpful suggestions is also extended to Dr. Walter Rogers, Agriculture Economics Department, Faculty of Agriculture, University of Alberta, to members of the Provincial ARDA Advisory Committee and to all others who reviewed the report.

Appreciation is also extended to Mrs. Joanne Tuffs for preparing the format and to Miss Sylvia Smart for typing the manuscript.

STATISTICAL SUMMARY OF LESSER SLAVE LAKE AREA

Area of Land in the Flood Zone	55,179 Acres
Improved Patented Land	9,658 Acres
Unimproved Patented Land	11,238 Acres
Indian Reserves	11,178 Acres
Crown Land	23,105 Acres
Average Area Flooded Per Year Since 1915	12,839 Acres
Average Area Which Would Have Been Flooded Per Year If Canal Was Excavated	742 Acres
Critical Lake Level	1,892.0 Feet
Maximum Lake Level (1935)	1,898.9 Feet
Maximum Saturation Level	1,900.9 Feet
Closest Contour Line to 1,900.9 Feet	1,902.0 Feet
Probability of Flooding Without Canal	23.4 Years Out of 100 Years.
Probability of Flooding With Canal	1.3 Years Out of 100 Years.
Number of Property Owners in Flood Zone	Approximately 100.
Number of Full-Time Farmers With Some Land in Flood Zone	Approximately 50.
Average Appraised Value of Land Below 1,897 Feet	$ 8.32 Per Acre.
Average Appraised Value of Land Above 1,897 Feet	$57.65 Per Acre.
Estimated Cost of Canal (5½ Miles Long)	$3,447,900
Estimated Annual Maintenance Cost of Canal ($20,000 Per Mile Per Year)	$ 110,000

SUMMARY

Flooding of land surrounding Lesser Slave Lake has always been a chronic problem. This flooding has resulted from a combination of factors including rising lake levels, rivers overflowing their banks and excessive precipitation on level land. The total area flooded by each of these factors is unknown and in this study, only the land flooded by the lake was considered.

There appear to be a number of alternatives to consider which would alleviate the hardships of local residents. Among these alternatives are:

1. Excavation of a canal to lower the lake level.

2. Purchase of all lands in the flood zone and provision of rehabilitation assistance to persons displaced.

3. Purchase of total holding, regardless of the proportion in the flood zone, and provision of rehabilitation assistance for those concerned.

4. Implementation of programs for emergency fodder and pasture requirements.

The following is a brief discussion of each of these alternatives.

1. Excavation of a canal at the east end of the lake, according to the engineering data supplied to Water Resources Division by Montreal Engineering Co. Ltd., would lower the lake level 3.1 feet. The additional width and depth of this canal would maintain water levels of the lake between 1,888 feet and 1,895 feet, or a range of seven feet. Benefits due to the canal include reduction of land flooded during periods of excessive water precipitation, reduction of property damage and stabilization of water levels on beaches used for recreational purposes. Disadvantages include the probable reduction in the number of fish maturing in the lake and reduction of nesting grounds for wild fowl. The tangible benefits for which estimates could be obtained are less than the costs. Consequently, the excavation of a canal does not appear to be

feasible at this time. Perhaps at some future date if downstream benefits are deemed possible, the feasibility of a canal could be re-examined.

2. A second alternative is the purchase of all lands in the flood zone to be leased back to the present or other operators at a rate which would return the original investment over a given period of time. The value of land was based on the assessment of a random sample appraised by a qualified assessor. This value is somewhat lower than that stated by present owners.

This transaction would permit present owners to relocate in another area if they wished to do so, transfer to another occupation (with rehabilitation assistance), or to remain in the area as tenants of present holdings in the flood zone.

It is evident that this alternative is unacceptable to a large proportion of the local residents as many would not sell under any circumstances. Furthermore this approach would not solve the chronic problem when accompanied by a program of rehabilitation and farm consolidation.

3. The third alternative is to purchase complete holdings, some of which may be located outside the flood zone, from owners who indicated a willingness to sell. This is similar to the second alternative except that only lands offered for sale would be purchased by the government. According to aspirations expressed in mid 1966, approximately 50% of the landowners in the flood zone were willing to consider selling their land and either renting it back, relocating, retraining for another vocation or retiring.

As in the previous alternative, it was assumed that the initial cost of the land could be recovered by the government by leasing the land to present owners or to other individuals at an annual rental of 6.45% of the purchase price and that the rental fees would be cancelled during years of flooding by the lake.

A program incorporating part or all of this alternative would permit employment to new vocations, provide assistance to those who wish to be relieved of the risk and uncertainty of flooding and would facilitate farm enlargement and consolidation.

The number of persons who indicated an interest in selling all or part of their holdings was approximately 50 per cent of those interviewed. However, the number that would consider selling at some future date may differ substantially from that at the present time depending on the alternatives available, the appraised price of the land and their present operations.

4. The fourth alternative is the provision of long term fodder supplies, including the construction of hay or silage storage facilites and the development of a community pasture to be used only in years of severe flooding of existing pasture land. This alternative would permit more stable development of the livestock economy insofar as operators would be able to maintain existing herds instead of having to sell livestock because of a shortage of hay or pasture. It would not decrease the risk and uncertainty of having land flooded, nor would it reduce the amount of property damage in land situated in the flood zone. Furthermore, this alternative would require continuous administration and would be severely limited by the inability to predict years when floods might occur.

SUMMARY OF COSTS AND BENEFITS
AMORTIZED OVER 100 YEARS

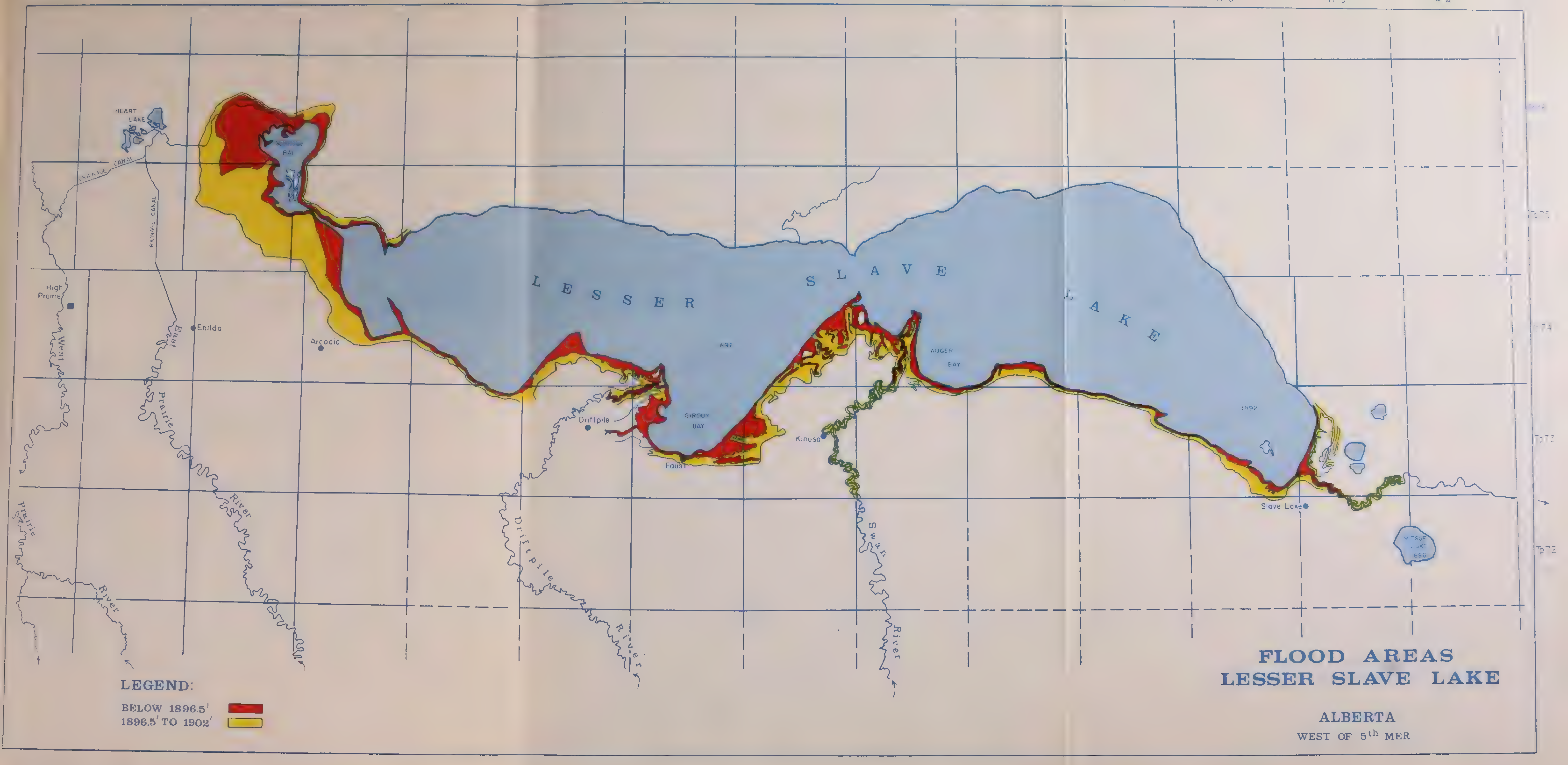
	Annual Amortized Costs	Annual Amortized Benefits
Excavation of Canal.	$330,000	$188,000
Purchase of All Lands in Flood Zone and Reallocation on a Rental Basis.	$ 76,500	$ 74,000
Purchase Only Lands Which Present Owners Indicate a Willingness to Sell and Reallocate on a Rental Basis.	$ 68,500	$ 65,500
Provision of Emergency Supplies of Fodder and Pasture.	$ 44,000	Intangible. Lends Stability to Economy.
Leave As Is.	$ 54,000	Nil.

Notes

(1) Value of land based on appraisal by a qualified appraisor. This is lower than the value expressed by present owners in most cases.

(2) Interest rate of 5.65 per cent based on cost of money from Alberta Municipal Financing Corporation since its inception.

(3) Area of land in the flood zone derived from contour maps by Water Resources Division.



FLOOD AREAS
LESSER SLAVE LAKE

ALBERTA
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LESSER SLAVE LAKE STUDY

INTRODUCTION

Flooding of land adjacent to the shores of Lesser Slave Lake has always been a chronic problem in the area. The first major recorded flood occurred in 1920; however, recorded lake levels prior to 1915 are unavailable. Since 1920, flooding has occurred in about a seven-year cycle. The highest lake level occurred in 1935, and the most prolonged period of flooding extended from 1963 to 1965 inclusive.

There is no doubt that the flooding of land has adversely affected the economic and social development of the area.

- farmers have had reduced incomes due to their inability to cultivate low-lying lands.

- the original town of Slave Lake was flooded periodically and it was moved to higher ground.

- extensive damage was done to property in the town of Faust in 1935.

- periodic damage has occurred to fences, buildings, roads, and the railroad.

- the threat of flooding has also reduced the amount of land which might otherwise have been brought under cultivation.

The flooding problem was first studied in 1920 by the federal government. A report1/ of the flood states that local inhabitants estimate that 200,000 acres of land were flooded and made unprofitable through the rising of Lesser

---

1/ An excerpt from the annual report of the Reclamation Service, Government of Canada, 1920-21.

Slave Lake in 1920. The report adds, however, that this area includes flooded land lying at a considerable distance from the lake in the Heart, Iroquois, and East and West Prairie River Basins. The report also states that much of this land has an elevation of 30 or 40 feet above the level of Lesser Slave Lake, and so could not be affected by high water levels.

In order to obtain more information on the magnitude of flooding and to assess alternative means of attacking the problem, a study was undertaken in the summer of 1966 by the Rural Development Research Branch of the Economics Division in co-operation with the Water Resources Division.

OBJECTIVES OF STUDY

The study was designed to investigate alternative means of eliminating or reducing the damage caused by the rising levels of Lesser Slave Lake. Two main alternatives were suggested. The first involved lowering the level of the lake by excavating a canal at the east end paralleling the Lesser Slave River. The second alternative involved purchasing low-lying lands from owners who wish to sell and thus be relieved of the risk and uncertainty due to periodic floods.

In order to measure the feasibility of constructing a canal, it was necessary to compare the estimated benefits which might accrue from lowering the lake level with the estimated cost of construction and maintenance of the canal.

SOURCES OF DATA

The Water Resources Division, Alberta Department of Agriculture, provided data on the maximum levels of the lake from 1915 to 1966. In addition, this Division employed the services of Spartan Airways Limited to photograph the flood zone in the summer of 1965. From these photographs contour maps were drawn with contour lines at five foot intervals. The Water Resources Division then obtained acreages between the contour lines of 1,897 to 1,902 feet and from the original survey lines to 1,897 feet. The Water Resources Division also employed the services of Montreal Engineering Company to supply physical measurements of a canal which would confine the maximum levels of the lake between elevations of 1,888 feet and 1,895 feet. This company also provided estimates on the costs involved in excavating the dam.

Production data for farms in the area was obtained from the records of the Farm Management Groups in the Peace River area because data on farms in the vicinity of Slave Lake was not obtainable for any year when floods did not occur. By employing this methodology, it is assumed that the productivity of land in the Slave Lake region is comparable to the land in the Farm Management Groups in the Peace River area. It is recognized that the Farm Management Groups generally are superior farmers, and that flooding by rivers in the Slave Lake region will continue to be a problem, regardless of whether or not a canal is excavated.

Other information pertaining to the personal aspirations of residents, amounts of damage in 1965, sizes of holdings and types of farming operations were obtained from a survey of the majority of landowners.

DESCRIPTION OF THE AREA

Lesser Slave Lake, located about 132 miles northwest of Edmonton, is Alberta's largest lake with some 460 square miles of surface. It is approximately 60 miles long (from east to west), and averages 8.3 miles in width. Its watershed extends approximately 25 miles west, 50 miles south and 15 miles north of the lake. Five rivers flow into the lake: the Heart, the East and

West Prairie, the Driftpile, and the Swan.

The lake's only outlet is the Lesser Slave River at the east end of the lake. Discharge into this river is under one million acre-feet per year.[1/] The upper 17 miles of the Slave River meanders over silt or fine sand, with an average drop of ½ foot per mile. It drains through a wooded area into the Athabasca River.

The topography around the lake varies considerably. At the east end, a sand dune runs parallel, north and south, to the lakeshore. Hilly and heavily wooded land is found between Slave Lake and Kinuso. An extremely flat plateau lies at the west end of the lake where the land, 10 or 12 miles from the lakeshore, is only 10 feet higher than the lake itself.

The area on the north shore is in the green zone and therefore not available for settlement at the present time. There are agricultural holdings at the east end, the west end and along the south side of the lake, with major concentrations near the towns of Slave Lake, Kinuso, Driftpile and north of Enilda.

There are numerous mink ranchers in or near towns on the south shore. While mink ranching constitutes the basic industry, other agricultural enterprises constitute an important segment of the region's economy. In recent years, oil exploration has increased rapidly. Fishing, largely by mink ranchers, is another important part of the local economy. There are 7 full-time fishermen and over 200 part-time fishermen in the summer.

[1/] Report by the Regulation of Lesser Slave Lake by Montreal Engineering Company, p. 4. Available from Water Resources Division, Alberta Department of Agriculture.

PROGRAMS AND PROJECTS OF OTHER AGENCIES

The Water Resources Division, Alberta Department of Agriculture, has maintained lake level measuring gauges for 52 years. They have measured the elevations of land in the flood area from aerial photographs taken in 1965. The Water Resources Division has also estimated the cost of constructing the canal as well as the cost of maintaining a canal over a period of 100 years.

In order to improve land drainage at the west end of Lesser Slave Lake, the Water Resources Division has excavated a canal through low-lying land to the East Prairie River. A second drainage ditch is now under construction and will drain land adjacent to the West Prairie River.

The Department of Municipal Affairs has reduced taxes on flooded land to ease the burden of the property holders affected. The Department of Lands and Forests has withheld from sale certain lands which were in the flood zone. This department is also instrumental in establishing parks on the east and south sides of the lake.

CAUSES OF FLOODING

There are several causes of flooding of land in the vicinity of Lesser Slave Lake. They are as follows:

(1) Rising Lake Levels - The actual level of the lake is well documented and the area flooded will be presented in a later section. In establishing the terms of reference for this study, only that land which is flooded by the lake was considered.

(2) Rivers Overflowing Their Banks - Because of the meandering rivers, a considerable amount of land in the area is flooded by rivers overflowing

their banks. At the present time, no estimate is available on the average number of acres flooded by rivers. While a certain amount of flooding from rivers will be due to "back-up effect" or the inability of rivers to drain into the lake, it is assumed in this report that flooding from rivers at two or more feet above the level of the lake is not the result of high lake levels.

(3) Inadequate Drainage - Because much of the land is relatively level, drainage is incomplete during periods of heavy precipitation. The amount of moisture on this land from rainfall alone renders it unsuitable for cultivation and damages standing crops or hay in the field or in a stack.

(4) A Combination of All of the Factors - In many instances, the rising level of the lake, the overflowing of the rivers and poor drainage combine to damage property and render the land unsuitable for agriculture.

DEFINITION OF FLOODING

In order to determine the acreage of the area flooded, it was necessary to define the level of the lake at which flooding begins. The elevation of 1,892.0 feet above sea level was selected as the critical flood level. Water rising to an elevation at or below this level would not be considered flooding, whereas a lake level exceeding 1,892.0 would be termed flooding. There were a number of reasons for selecting this elevation as the critical point.

(1) According to information supplied by the Water Resources Division, the elevation of original survey lines varied from 1,893.6 to 1,898.9. See Table III. The elevation of 1,892 was considered to be the highest level that the lake could attain without saturating land lying above the original survey delineation.

(2) Land extending a vertical distance of two feet above the level of the

lake was considered to be saturated and therefore not suitable for cultivation. Accordingly, the critical lake level would be two feet below the original survey line (1,894.0 essentially) or 1,892.0 feet above sea level.

(3) It is recognized that farm operations are being conducted on land below 1,894.0 during periods of low water levels. However, if the canal was excavated and the water level lowered artificially, some land below the original survey line would revert to the Crown depending on the wording in the original title. (See letter in appendix.)

LAKE ELEVATIONS

Lake elevations have fluctuated from a low level of 1,888.6 feet above sea level in 1939 to a high of 1,898.9 feet in 1935. Since records were first kept in 1915, the lake level has risen above 1,892.0 feet a total of 31 times. Periods of flooding are grouped in consecutive years, indicating that there may be a residual effect on lake levels from one year to the next. (See Table I appendix.)

The average annual maximum level of the lake since 1915 as calculated from Table I appendix is 1,892.7 feet above sea level. Similarily, the average maximum level of the lake that would have occurred if a canal had been excavated is 1,889.6, or a reduction in maximum levels of the lake of 3.1 feet. The simulated lake levels were calculated from data supplied from Water Resources Division.

Details of a proposed channel at the east end of the lake may be obtained from the Water Resources Division. If a channel was excavated, the lake fluctuations would be confined between the elevations of 1,888 and 1,895 feet.

PROBABILITY OF FLOODING

The probability of an acre of land being flooded in any year was obtained by dividing the average number of acres flood annually by the total acreage in the flood zone. There was a total of 667,646 acres flooded since 1915 (a span of 52 years). The average number of acres flooded annually would be 667,646 divided by 52 or 12,839 acres.

Similarily, according to the terms of reference, if a canal was excavated the maximum lake elevation would be 1,895 feet. This would occur during a year resembling 1935. Adding to this elevation the two feet above the water level which is considered saturated, the effective saturation level would be 1,897 feet, or an elevation where 33,100 acres would be considered unsuitable for cultivation. The average annual number of acres flooded, with a canal to lower the lake level, would be 38,605 divided by 52 or 742 acres.

The probability of flooding was then determined by dividing the average annual number of acres flooded by the total number of acres in the flood zone (54,779 acres).

The probability of flooding without the canal is:

$$\frac{12,839}{54,779} = .234 \text{ or a likelihood of 23.4 years out of 100.}$$

Similarily, the probability of flooding with a canal installed would be:

$$\frac{742}{54,779} = .013 \text{ or 1.3 years out of 100.}$$

DURATION OF FLOODS

The time of year when flooding begins is an important factor in determining losses in the agricultural sector. Farmers seeding crops and then having their land flooded lose not only the net income normally expected, but also the cost of seed and seeding operations. This would not apply to hay where harvesting is the only operation involved; however, at times, water has risen rapidly, preventing the farmer from removing hay from affected fields.

The table below shows the approximate duration of flooding as measured by the gauge at Slave Lake up to 1927 and, subsequently, by the gauge at Faust.

TABLE I APPROXIMATE DURATION OF FLOODING**

Lesser Slave Lake

Year	Beginning Of Flood	End Of Flood
1920	June 12	All Fall
1927	July 9	Sept. 17
1930	June 17	Aug. 26
1934	July 10	Oct. 16
1935	ALL GROWING	SEASON
1936	May 10 (Approx.)	Oct. 30
1955	July 13	July 26
*1956	July 11	July 17
1963	May 25	July 4
1964	Aug. 11	After Oct. 31
1965	April 30	Nov. 24

Source: Water Resources Division, Alberta Department of Agriculture.

* Reached approximately the 1894.5 foot level.

** Years when cereal crop production was severely affected.

Lake levels were sufficiently high to be considered at flood stage for the complete growing season of the year 1935. Flooding began in April in the year 1965, in May in 1936 and 1963, and in June for the years 1920 and 1930. In 1927, 1934, 1955, and 1956, flooding began in the month of July, and in 1964, in the month of August.

AREA OF LAND IN THE FLOOD ZONE

The highest elevation was selected by adding a two-foot saturation level to the highest water level of 1,898.9 to result in the maximum saturation level of 1,900.9 feet. However, as there was no contour line at this elevation, the one closest to it, 1,902 feet, was used. Acreage in the flood zone was computed on the basis of a linear relationship between elevation and acreage.

The area was sub-divided into two major sub-areas: namely, from the original survey line of the patented land to 1,897 and from 1,897 to 1,902 feet. The area of land flooded or not flooded will vary, of course, according to the level of the lake. However, in order to obtain a figure, it appeared desirable to use the original survey line to delineate the low level because, it, presumably, marked the line at which the vegetation changed and, accordingly, identified that portion of a particular parcel to which the owner had title and on which assessments and taxes were based. It is recognized, however, that most of the land along the lake is governed by riparian rights. Under riparian rights, land covered by water belongs to the Crown; whereas, land not covered by water belongs to the title holder. Accordingly, when the water recedes, the landowner has title to more land than that shown on his original deed. On the other hand, if the lake level rises, the landowner actually has title to less than was indicated by his title.

According to the solicitor, Department of Lands and Forests,[1/] riparian rights do not apply if the lake level is dropped artificially. It would, therefore, appear likely that if a canal was excavated, the amount of land owned by landlords adjacent to the lake would, in fact, be that area delineated by the original survey mark and would not include the area extending from the original survey line, as shown in the deed, to the new level of the lake.

The area of land in the flood zone is shown in the following table:

TABLE II

AREA AND TENURE OF LAND IN THE FLOOD ZONE (ACRES)

Elevation	Patented	Crown	Indian Reserves	Total
Above 1,897	11,326	5,939	4,814	22,079
Below 1,897	9,570	17,166	6,364	33,100
TOTAL	20,896	23,105	11,178	55,179

Source: Water Resources Division.

AREA OF LAND FLOODED

In order to average the acreage of land flooded per year, the lake elevation was related to the total area of land in the flood zone. It was assumed that the gradient within each of the sub-areas, i.e. between 1,894.0 and 1,897 feet, and between 1,897 and 1,902 feet was constant. A two-foot saturation level was added to the high water mark of a particular year to obtain the highest level of land rendered unsuitable for cultivation by lake flooding.

[1/] Private Communication.

By assuming a linear relationship between elevations and acreages in each level, the area of land which was flooded and the amount that would have been flooded had a canal been in place, was calculated and is referred to as the flood zone.

The average number of acres flooded per year, since 1915, is 12,839. It is estimated that the average acreage that would have been flooded if the canal had been in operation is 742.

TABLE III

ELEVATION OF ORIGINAL SURVEY BOUNDARIES

Year	Elevation of Survey Boundary (Ft. Above Sea Level)	Elevation of Water's Edge (Ft. Above Sea Level)
1908	1,893.6	1,891.0
1908	1,898.9	1,890.5
1908	1,898.1	1,893.1
1913	1,898.1	1,890.8
1913	1,894.3	-------
1913	1,894.1	1,891.1

Source: Water Resources Division.

LAND TENURE

Land within the flood zone has been classified into three categories of tenure: Crown, patented or leading to patent, and Indian Reserves. The acreages were obtained from township maps in the district office of the Department of Municipal Affairs at High Prairie, from the records of the Department of Municipal Affairs and the Water Resources Division in Edmonton.

Slightly in excess of 23,000 acres are owned by the Crown and a substantial part of this area is not available for disposition because of the threat of flooding. Land on the north shore is not included in the totals, but, even if considered, would not add materially to the sum of land in the flood zone because of the relatively steep slope of the north shoreline. Crown land constitutes over 50 per cent of the land at the elevation of 1,897 and below; whereas, patented or leading to patent comprises half of the land between 1,897 and 1,902 elevation.

LAND VALUES

A random sample of land parcels was appraised by an officer of the Department of Lands and Forest. These appraisals, designed to determine the present market value of both land and improvements, were made in the fall of 1966.

Parcels chosen below the 1,897 level did not have buildings. Market values, including improvements, ranged from $8.00 to $10.00 per acre, and averaged $8.32 per acre.

Land above the elevation of 1,897 varied in present market price per acre from $8.00 to $118.00 including improvements, with a weighted average price per acre of $57.65.

Information on the method used to determine the present market value is available from the Department of Lands and Forests.

CONDITIONS OF LAND

Practically all of the Crown land and the Indian reserves are unimproved at the present time. However, with improved drainage of marsh land, some control of river flooding and the stabilization of lake levels, more land could be used for crop production.

According to a survey of the farmers in the fall of 1966, approximately 46 per cent of the patented land is improved and 6 per cent of it is considered waste because of topography, stoniness, or some other factor. It is assumed that approximately 6 per cent of the Indian Reserves and Crown land would also be waste.

A portion of the unimproved land would be brought under cultivation if the threat of flooding was removed. In order to arrive at the percentage of land in this category, the Water Resources Division in collaberation with the Economics Division estimated that 35 per cent of the presently unimproved land could be brought into production if the threat of flooding by the lake was eliminated. The remaining unimproved land was considered potentially arable but severely limited because of flooding by rivers or excessive precipitation on low-lying marshes or bogs.

The following table shows the condition of land surrounding Lesser Slave Lake:

TABLE IV

CONDITION OF LAND
LESSER SLAVE LAKE AREA

	Acres	Percent
Improved	9,658	17
Probably will be improved if a canal is built.	14,773	27
Potentially arable but is limited because of drainage and other factors.	27,437	50
Waste	3,311	6
TOTAL	55,179	100

Source: Water Resources and Economics Division.

LAND USE

The predominant use of land below the 1,897 level is for the production of hay or for pasture. However, exact figures are unobtainable because the contour line dissects numerous parcels. Use of land above this elevation is divided approximately as follows: Wheat - 2 per cent, oats - 7 per cent, barley - 15 per cent, flax - 2 per cent, rape - 3 per cent, summerfallow - 2 per cent, hay - 28 per cent, pasture - 13 per cent, flooded - 22 per cent, waste - 6 per cent.

When questioned about changes which they would incorporate in their farming operations, the farmers' replies were divided equally between growing more cereal crops and grazing more cattle. The farmers in the lower level were unanimous in that they would grow less hay.

SOIL RATINGS

Detailed soil ratings have been compiled by the Research Council of Alberta on land adjacent to the west end of the lake. (Refer to the Soil Survey of the High Prairie and McLennan Sheets. Report No. 63.) Most of the soil in the flood zone is classed as fair to fairly good arable.

A preliminary soil survey was conducted on the remainder of the area, extending from the east end of the lake to Range 14. (Refer to Exploratory Soil Survey of Alberta Map Sheets, 83-0, 83-P, and 73-M. Research Council of Alberta Report 64-1.) The area in Range 5 and 6 is classed as predominantly potentially arable. Land extending from the Swan River west to Range 14 is also classed as potentially arable, while the area between these two sections is classed as doubtful arable. The latter comprises a relatively small fraction of the total land in the flood zone.

MINK RANCHING

One hundred and thirty ranchers are located along the lake as follows:

TABLE V MINK RANCHERS IN LESSER SLAVE LAKE AREA

Location	Number of Ranchers	No. of Mink on Hand Aug. 31/66
Canyon Creek	24	19,314
Kinuso	9	3,571
Faust	24	21,674
Slave Lake	9	6,535
Joussard	29	12,985
Widewater	35	42,697
	130	106,776

Source: Fur Farms Branch, Alberta Department of Agriculture.

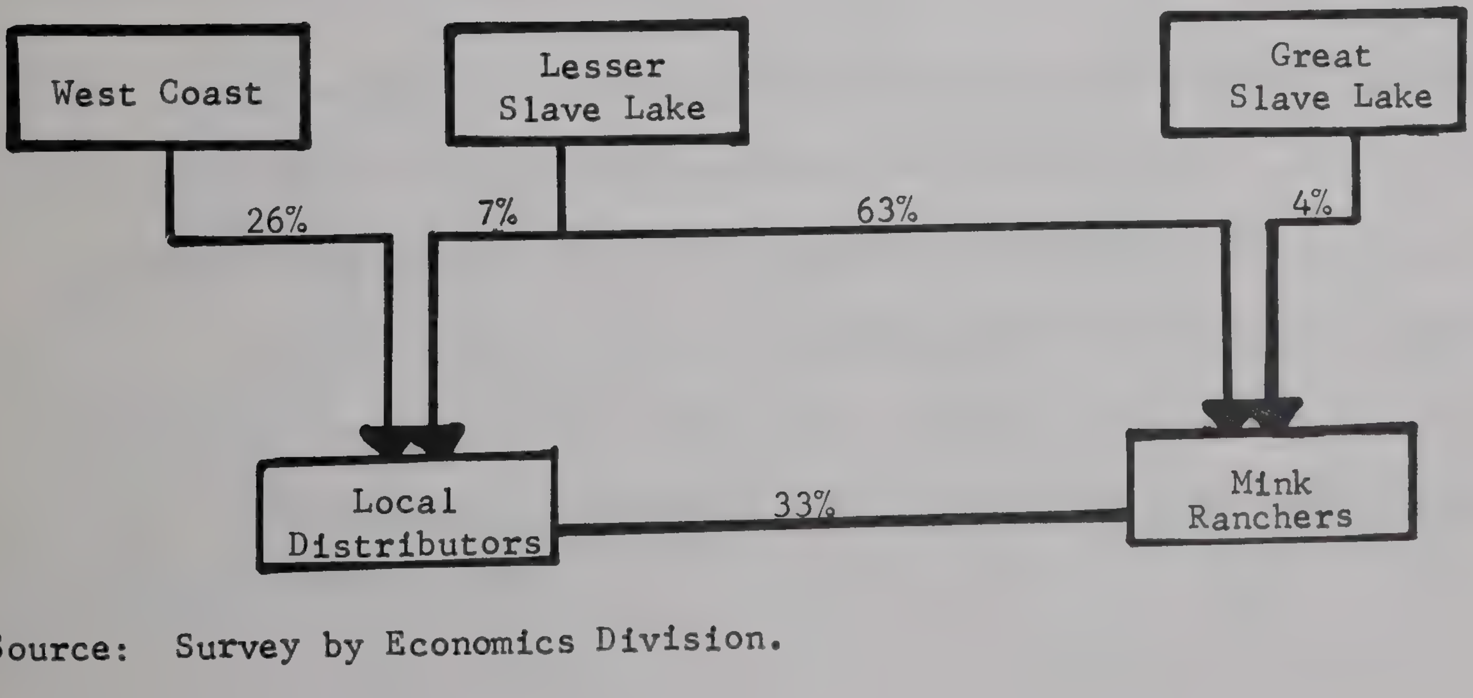
The primary reason for the development of mink ranches in the area is the availability of fish for mink feed. Should the fish become unavailable, the ranchers say they would have to relocate or change vocations. The sale of mink pelts amounts to approximately one million dollars per year, according to the Fur Farms Branch. Considering that this is more than twice the amount received from the sale of agricultural products produced in the flood zone, the importance of mink ranching to the local economy cannot be overemphasized.

Tullibee in Lesser Slave Lake is used almost exclusively for mink feed as it has little market value for human consumption and because of the high incidence of cysts of triaenophoras in the flesh.

It is estimated that 70 per cent of the fish used in mink feed comes from Lesser Slave Lake. The remainder comes from Great Slave Lake and the West Coast as shown below:

FIGURE I

ORIGIN OF FISH USED FOR MINK FEED
Lesser Slave Lake - 1966



Source: Survey by Economics Division.

The cost of fish to the rancher is about the same whether from Lesser Slave Lake or Great Slave Lake but is fractionally higher if imported from the Coast.

The approximate cost from each of the three sources is shown in the following table:

TABLE VI

THE COSTS OF FISH IN MINK FEED - 1966

	Cost Per Lb. By Source		
Type of Cost	Lesser Slave Lake	West Coast	Great Slave Lake
Average Cost to Distributors	$.048	$.055	$.045
Handling Costs	.005	.005	.018
Freezing/Storage Costs	.010	.010	----
Total Cost to Mink Ranchers	$.063	$.070	$.063

Source: Survey by Economics Division.

Although there is less than a cent difference in price per pound, the ranchers indicated a preference for local fish because fish from Lesser Slave Lake are usually fresher than that from other sources and, according to ranchers, produce more desirable pelts.

The relative costs of fishing in the summer and winter are shown in the following table.

TABLE VII

FISHERMEN'S COSTS
For Catch of 1,500 Pounds Per Day

Materials	Summer	Winter
Gas	$ 1.00	$ 2.00
Oil	.35	.70
Labour	45.00	60.00
Overhead		
Nets -	4.00	8.00
Boat/Bombardier	2.00	4.00
Cost of Fishing	$52.35	$74.70
Total Catch (lbs.)	1,500	1,500
Cost Per Pound	.035	.050
Average Selling Price Per Pound	.048	.048
AVERAGE PROFIT	.013	(.002) LOSS

Source: Survey by Economics Division.

In order to evaluate the effect on the mink industry of lowering the lake, we must assess any possible change in the amount of fish available for feed. This will be considered in the next section.

Other questions that would have to be answered include:

(1) Would the price of imported fish increase if the local supply was reduced?

(2) Will tullibee be reclassified for human consumption? If so, will it become more expensive?

FISHING

Seven full-time and over two hundred part-time fishermen work Lesser Slave Lake, catching an average of over four million pounds annually. In some years, tullibee alone has yielded this amount, while whitefish has frequently exceeded one million pounds annually.

The average yield by species is listed below:

TABLE VIII

AVERAGE ANNUAL FISH CATCH OF LESSER SLAVE LAKE
(1951 - 1961)

Species	Pounds
Tullibee	3,075,000 lbs.
Whitefish	788,660 lbs.
Pickerel	290,870 lbs.
Pike	81,620 lbs.
Perch	29,660 lbs.
Other	91,950 lbs.
TOTAL	4,357,760 lbs.

Average Fish Sales $242,000

Source: Economic Report on Alberta's Peace River Country.
Northern Alberta Development Council, 1966, p. 26.

According to the Fish and Wildlife Division, a number of studies have been conducted on the influence of fluctuating lake levels on fish production in lakes. Unfortunately, most of this research has not progressed far enough to permit definite conclusions to be drawn.

Comparisons between water levels and fish production in Lesser Slave Lake, based on available data, strongly suggest that there is a relationship between high water and good fish production. The spawning season for whitefish and tullibee is from late October through November. The young are hatched in early spring. If the eggs are deposited in relatively shallow water as they probably are during low water levels, their survival would be jeopardized by ice formation and the effect would be increased if there was any significant lowering of the water level during the winter. In addition, prevailing wind direction and wind velocities in late fall, as well as water temperatures, freeze-up dates and thickness of ice cover are factors involved in determining spawning and survival success of fish.

High water levels which back up water in the mouths of inlet streams and flood marshy low-lying lands adjacent to lakes are almost certain to be beneficial to pike production. This species could become more important both commercially and for recreational fishing if its numbers were increased through provision of good spawning conditions.

WILD FOWL AND FURBEARING ANIMALS

The area near Buffalo Bay and other lowlands surrounding Lesser Slave Lake are among the best, if not the finest, waterfowl production and staging areas of northern Alberta. This area also constitutes an excellent furbearer habitat, particularly for muskrat and beaver.

According to Gordon Kerr, Wildlife Biologist, Fish and Wildlife Division, the entire Buffalo Bay area and adjoining areas would be lost as waterfowl and furbearer habitats if the water level was dropped two and one-half feet. He adds, however, that it is possible that another area of equal productivity might be created. More information is required to compute a realistic economic appraisal of such a loss.

Also to be considered is the fact that migratory waterfowl is an international resource shared by Canada, U. S. A. and Mexico. Apparently there is no agreement governing the care and management of such birds by one country that can be invoked by another nation.

Mr. Kerr suggests that it is reasonable to place a value of over one million dollars annually on the entire wildlife resource of the area. However, the reduction in value of this resource that would occur if the lake was lowered is unknown.

RECREATION AND TOURISM

The evaluation of additional recreational benefits which would develop in the area is perhaps the most difficult task related to water level control. Information required to compute eventual demand is varied and in some instances non-existent. A brief discussion of some of the factors influencing the potential recreational development follows.

The participation in recreational activities will vary according to population, particularly within one hour's driving distance of the south shore line of the lake, the per capita disposable income, the duration of paid vacations, and improvements in transportation facilities.

Increases in the proportion of leisure time by local people is also an important factor. It would appear likely that some population growth will occur and that people will have greater disposable incomes and more leisure time. However, the degree of population growth has not been estimated.

Environmental factors lend both advantages and disadvantages to recreation at the lake. Vast stretches of excellent sand in which there is virtually no gravel extend around much of the lake, making the beaches some of the finest that can be found anywhere. The periodic rise of water during floods is a deterrent to the utilization of these excellent beaches, but to what extent their use is discouraged is difficult to estimate without data extending over a series of years. The average water temperature is approximately four degrees lower in Lesser Slave Lake during the months of July and August than in other lakes in the province.[1] The lower temperature will not be conducive to swimming.

Alternative facilities need to be considered when discussing the increasing use of the lake for recreational purposes. Recreational areas are located at Shaw's Point at the northwest corner, a proposed provincial campsite in the northeast, commercial cabins immediately north of the old town of Slave Lake, and near Kinuso. In all areas, except the latter, the facilities are located on high ground which is not subject to flooding. These areas will continue to develop but would probably show more rapid growth if the water level was controlled. In addition, an attractive recreational site serving the more populated area of the west, High Prairie, Peace River, etc., is located at Winagami Lake.

Although, Edmonton residents would not use the facilities of Slave Lake for one-day trips, improved road conditions will lead to increased patronage of Slave Lake in the future. However, relatively limited use of the lake will persist because of the proximity of numerous lakes to the city of Edmonton.

The use made of the lake for recreational purposes will influence the

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1/ Source: M. Paetz, Fish and Wildlife Division, Department of Lands and Forests.

feasibility of controlling the lake level. For example, the level of the lake would not affect sport fishing, boating, skiing or swimming. However, these uses will depend, in part, on the permanent structures to be erected such as cabins, playgrounds, and beach houses. Obviously, water level control is important in preventing damage to permanent structures, particularly in the Kinuso area.

In summary, the recreational benefits will depend on the number of persons using the lake, the affluence of the economy, environmental factors, recreational uses, the disadvantage to wild fowl and competitive facilities in other areas. Moreover, only the increase in use of the lake for recreational purposes that would develop with water level control compared to that which might materialize without the canal would be a required measurement for evaluation. Once data is available for enumerating the factors mentioned above, it will be possible to economically assess the value of benefits to recreation, tourism and wildlife.

BASIS FOR CALCULATION OF BENEFITS

There is a wide range of possible benefits arising from the excavation of a canal at the east end of Lesser Slave Lake. An attempt was made to measure the increase in revenue which would accrue to the area if the canal was excavated. The benefits include the increase in the value of agricultural products produced on the existing farms, the prevention of losses from damage to property, the returns to land which would be developed if the threat of flooding was reduced and the increase in the volume of sales of local businessmen. In addition, benefits credited to a canal include the costs of summerfallowing and seeding operations on land which was flooded in the middle of the growing season and where no crop was subsequently harvested.

Benefits may be divided into two classes: primary and secondary. Primary benefits are the increased value of goods and services produced as a result of the project and the reduction in damage to property. Secondary benefits, such as greater consumption of goods, are added over and above the primary benefits as a result of activities "stemming from" or "induced by" the project. The net secondary benefits are used in the following calculations.

PRIMARY BENEFITS

The primary benefits considered in this study included three main items: the increase in revenue of farmers on the land they presently operate, the reduction of damage to property, and the potential increase in agricultural revenue if more land was brought into production.

Benefits to fishing, mink farming, recreation and tourism are excluded because of insufficient data to indicate whether incomes would be increased or decreased. As mentioned earlier, more basic research is required in these fields.

I. Increase in Revenue of Farmers Presently in the Area

The excavation of a canal would permit continuous use of land in the flood zone. Gross income per acre would constitute the benefits to a farmer because he already has an investment in machinery to operate both his flooded land and land at higher elevations as well as sufficient labour to perform the cultural operations required.

The amount of gross income per improved acre was not available on farms in the flood zone for a year when flooding did not occur. As a result, it was necessary to obtain information on a comparable area and to apply this data to the Lesser Slave Lake region.

The Farm Management Association in the Peace River area has maintained accurate records for a number of years and has had the records analyzed by the Farm Management Branch, Economics Division, Alberta Department of Agriculture. Data from the records of this Association was used in this study to estimate gross farm incomes of farmers in the flood zone.

The benefits on improved land as measured by gross farm income per acre were adjusted according to the date when flooding began and the number of acres summerfallowed the year before.

During periods when land is flooded, operators would lose the gross income per acre as well as the cost of summerfallow the previous year. However, because the land is flooded for part or all of the year, the operator would not be performing all of the cultural operations of a normal year. For instance, if the land was flooded in July, the operator would have acquired expenses for seed, fertilizer, gas, oil, etc., but because the crop was ruined, he would not perform the harvesting operations. Consequently, the estimated gross income per acre would be reduced by the amount of the harvesting operations. Similarly, if the crop was flooded before spring work began, the total costs of operating the land would be "saved". This amount is referred to as the variable costs per acre of improved land which, in the case of the operators in the Peace River Farm Management Groups, was $7.53 per improved acre.1/

By declaring a loss of gross farm income ($21.20 for the Farm Manage-

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1/ Farm Management Records of the Peace River Area
Farm Management Branch, Economics Division, Alberta Department of Agriculture.

ment Groups of the Peace River District), it is assumed that there is no alternative use for farm labour and capital.

The cost of summerfallowing the Peace River area is \$5.17 per acre.[1] However, because only five per cent of the improved land is summerfallowed, this cost has to be spread over the total area of improved land in the present study. Thus the cost of summerfallowing per improved acre in the Lesser Slave Lake area is \$5.17 x 5% = \$0.28.

In five out of the ten serious flood years, operators were unable to carry on any cultural operations, based on the dates of flooding presented earlier in this report. On the other hand, seeding operations were carried out five years out of the ten, if June 15 is taken as the date when seeding operations would have been completed. This is somewhat unrealistic for a number of farmers in the area. Thus, in five years out of ten, the variable operating costs were completely "saved" whereas in five years, only the harvesting costs (estimated at ½ variable operating costs) were not spent. Seeding costs would not have been incurred on hay or pasture land. In some instances, harvesting operations were performed and later the hay crop was destroyed due to flooding. The cost of these operations was discounted in view of the greater gross income per acre used to assess the losses.

The variable operating costs "saved per improved acre are calculated separately for the five years of complete flooding and five years of partial flooding as follows:

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[1] K. D. Porter and B. J. McBain - Oil Seeds and Wheat Production Cost Studies, 1963, p. 22.
Farm Management Branch, Economics Division, Alberta Department of Agriculture.

Complete flooding from the lake.
5/10 x \$7.53 = \$3.76

Partial flooding from the lake.
5/10 x \$7.53/2 = \$1.88

TOTAL \$5.64

The above indicates that when improved land is flooded, whether partially or for the whole growing season, the variable operating costs that are not spent amount to \$5.64 per acre.

II. Reduction of Damage to Property

Damage from lake flooding to property is generally confined to the agricultural sector and to the railroad. While extensive damage to residential property resulted from the 1935 flood and others in the towns of Slave Lake and Faust, remedial action by relocation has reduced the probability of damage occurring. Nevertheless, a number of old and frequently abandoned buildings remain in low lying areas and the real damage to these structures is negligible. It is apparent, however, that numerous residential and industrial buildings continue to be adversely affected by high water tables and flooding from rivers which are not directly related to rising lake levels.

A survey by the Economics Division in the summer of 1964 revealed that the damage to buildings and fences in 1966 amounted to approximately \$4,600. The cost of removing debris deposited on land was not included. In addition, the estimated annual damage to the Northern Alberta Railway amounted to \$1,827.[1]

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[1] Private Communication.

III. Changes in Land Use

If the threat of flooding was reduced, 35 per cent of the unimproved land, as estimated previously in this report, would be brought into production for agricultural purposes. (See Condition of Land.) The remaining acreages would remain susceptible to flooding by rivers and by excessive precipitation.

The potential benefits from this land would be the "return to land" as distinguished from gross farm income because the latter income reflects the return to capital, labour and management, as well as the return to land. In other words, additional inputs of capital, labour and management would have to be applied to the land in order to bring the land into production.

The return to land, derived from the Farm Management records of the Peace River Groups, amounted to $4.55 per acre.1/

SECONDARY BENEFITS

An increase in production of primary producers provides more employment to marketing agencies, truckers and railroads to haul the goods to market, or other businesses engaged in caring for goods between the initial producer and consumer. Profits realized from these types of operations are referred to as "stemming from" an increase in primary benefits.

In this study, a reasonable estimate of the profit derived by each agent in the marketing channel, would be difficult to calculate. In addition, only that portion of secondary benefits which apply to the local area was

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1/ Using multiple regression analysis by considering yield and size of farm in acres, the return to land amounted to $4.40 per improved acre.

considered of prime importance because it was assumed that, in an expanding economy, there would be alternative uses for labour and capital in other parts of the province or nation which might otherwise be used in processing the primary production from Lesser Slave Lake region. It is recognized that an adjustment to the amount of secondary benefits would have to be made if full employment was not assumed. In following the methodology contained in the "Economic Guide for Watershed Protection and Flood Control" by the Soil Conservation Service, U. S. Department of Agriculture, the amount of "stemming from" secondary benefits was considered to be 10 per cent of the primary benefits.

Other secondary benefits include increased incomes of persons engaged in retailing, real estate, insurance, etc. More land under cultivation would result in a greater demand for machinery, gas, oil, and fertilizers. More improved land could mean more farmers, and thus an increase in sales of groceries, clothing, and recreational items. In addition, most of the variable costs of maintaining the canal would be included as a secondary benefit. The cash variable costs of maintaining the canal were estimated by the Water Resources Division to be $50,000 annually. Secondary benefits resulting from higher incomes of the above agencies are referred to as "induced by" benefits.

Again, in calculating secondary benefits, the methodology used is cited by the Soil Conservation Service mentioned above. The value of the local "induced by" benefits is considered to be 10 per cent of the increased costs of primary producers resulting from the excavation of the canal. The costs, in this case, included both productive and consumptive costs which approximate increased gross incomes of primary producers and costs of maintaining the canal.

ASSUMPTIONS

1. The returns to land in the lower elevations could be the same as that on land above 1,897 feet.

2. At no time would land above 1,895 feet be flooded if a canal was excavated.

3. Prices received for farm products and costs of farm operations would remain constant.

4. The contour lines drawn on topographical maps are accurate.

5. The high water mark of the lake would drop from an average of 1,892.7 feet to 1,889.6 feet.

ANNUAL BENEFITS OF INSTALLATION OF A CANAL

PRIMARY BENEFITS

Improved Land

Gross Revenue Per Acre......................	$21.20	
Add Cost of Summerfallow Per Improved Acre...	0.28	$21.48
Less Variable Costs Per Improved Acre........	5.64	
Production Income Benefits from Each Improved Acre Reclaimed.........................		$15.84

Probability of Flooding......................	0.234	
Simulated Probability of Flooding............	0.013	
Reduction of Probability of Flooding Due to Canal................................		0.221

Number of Improved Acres in Flood Zone......	9,658	
Annual Potential Benefits From Improved Land		
9,658 x 0.221 x $15.84..................		$33,809

Unimproved Land

Number of Acres That Could Be Improved......	14,773	
Return to Land Per Acre Per Annum...........	$ 4.55	
Annual Potential Benefits From Unimproved Land		
14,773 x $4.55...........................		$67,217

Reduction in Damage

Estimated Annual Damage to Property, Fences, Etc......................................	$ 4,600	
Estimated Annual Damage to Railroad.........	$ 1,827	
Total Annual Damages........................	$ 6,427	$ 6,427
Total Annual Primary Benefits...............		$107,453

SECONDARY BENEFITS

Annual Benefits Stemming From Project	
$107,453 x 10%..........................	$10,745
Annual Benefits Induced By Project	
(a) From Increased Agricultural Income	
$33,809 + (14,773 x $21.20 x 10%)....	$65,043
(b) From Maintenance of Canal $50,000 x 10%	$ 5,000
Total Annual Secondary Benefits.............	$80,788

BASIS FOR CALCULATION OF COSTS

Costs are divided into two categories similar to benefits: Primary and Secondary.

Primary costs are the annual costs chargeable during the life of the project. These include the amortization with interest of the initial installation costs, the maintenance costs of the canal, and the costs of clearing and breaking the unimproved land. The life of the project was considered to be 100 years. The interest rate used was 5.65 per cent, which is the weighted average interest charged to municipalities by the Alberta Municipal Financing Corporation since the inception of the Corporation.1/

Because the secondary benefits referred to earlier were net, it is not necessary to examine the amount of the secondary costs or the gross primary benefits. For example, instead of implying that the benefits to the local grocery were one dollar for each dollar's worth of groceries purchased, and then subtracting ninety cents for the cost of groceries to the storekeeper, the benefits were calculated as 10 per cent of the value of the groceries purchased. Accordingly, secondary costs have already been considered when both the "induced by" and "stemming from" benefits were multiplied by 10 per cent to calculate the net secondary benefits.

The cost of a canal 5½ miles long was estimated in 1965 by Montreal Engineering Company at $2,554,000. However, according to the Water Resources Division, construction costs have risen 35 to 40 per cent since then, bringing the estimated costs up to $3,447,900. The annual cost of the installation over 100 years at 5.65 per cent interest is $196,350.

Annual maintenance costs are estimated by the Water Resources Division

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1/ Treasury Department, Government of Alberta.

at $20,000 per mile per year or $110,000 per annum.

Costs of clearing and of breaking on a number of parcels in a random sample was estimated by the Department of Lands and Forests at $17.00 and $11.00, respectively, per acre. Amortized over 100 years, these costs amount to $0.97 and $0.63 per acre of land to be improved. The number of acres that could be improved was estimated at 14,773 acres, as explained in Condition of Land.

CALCULATION OF PRIMARY COSTS (PER ANNUM)

Construction of Canal	$196,350
Maintenance Costs of Canal	$110,000
Costs of Clearing 14,773 Acres	$ 14,330
Costs of Breaking 14,773 Acres	$ 9,307
Total Primary Costs	$329,987

SUMMARY OF BENEFITS AND COSTS OF EXCAVATING CANAL

PRIMARY BENEFITS	$107,453
SECONDARY BENEFITS	$ 80,788
TOTAL BENEFITS	$188,241
PRIMARY COSTS	$329,987

ALTERNATIVES TO EXCAVATING CANAL

A number of alternatives to excavating a canal were examined, including the continuation of the present situation, the purchase of all land in the flood zone, the purchase of complete holdings, some of which may be located outside the flood zone, and the provision of emergency supplies of fodder and pasture. A brief discussion of each of these alternatives is presented below:

1. Continuation of Present Situation

The continuation of the present situation would result in a loss of income ranging from little or none in some years to as high as $300,000 during serious floods. This figure does not include the intangible losses attributable to instability of operations, inconveniences and discomforts, or the regression in the farming enterprise resulting from the necessity to dispose of breeding herds of cattle, etc.

The amortized cost of providing a subsidy of $21.20 for each improved acre flooded less damages & related costs would amount to approximately $54,000 annually. This alternative does not include flooding from any source other than the lake.

Practical application of this alternative could be severely handicapped by the necessity to differentiate between flooding from the lake and other causes of flooding.

2. Purchase All Land in the Flood Zone

This alternative would involve the purchase of all farm land within the flood zone. Provision would have to be made to rehabilitate the farmers presently residing within the area, either to a more suitable farming district, to another vocation which might involve training, or to retire on an allowance. Land above the 1,902 foot elevation would not be purchased, regardless of the proportion of holdings below the flood zone. The Indian Reserves were excluded from this alternative. However, consideration could be given to the resettlement of Indians in a more favourable location. The implementation of farm enlargement and farm consolidation policies should also be considered.

The area of patented land includes 9,570 acres below the 1,897 elevation and 21,104 acres extending from the 1,897 elevation to the 1,902 elevation including those portions of legal parcels above 1,902 feet which were dissected by the 1,902 contour line. Valuing the former at $8.32 per acre and the higher land at $57.65 per acre, the cost of land would be $1,296,268. In addition, the cost of relocating the forty-seven farmers who have their homes within the flood zone, at one thousand dollars per family, would raise the cost of this alternative to $1,343,268, or an annual amortized cost of $76,497 over 100 years.

The land purchased in this scheme could be used for a community pasture, wildlife preserve, or leased to operators in the area. Revenues derived from leases or other fees are benefits which could be credited to this alternative. The scale of fees for leases could vary, but if the project was to be self-liquidating, the rate of rentals would have to be 6.45 per cent of the purchase price. This rate would permit the cancellation of rental fees if flooding occurred.

This alternative has little practical application since many local residents would not consider selling under any circumstances.

3. Purchase Land From Operators Who Wish to Sell

The third alternative is to purchase only those farms which operators are willing to sell. While many operators indicated they would be willing to sell only a fraction of their total unit, the costs listed below include the expenditures which would be necessary to purchase the total holdings of the operator. Consequently, the costs may be substantially reduced from that indicated.

Of approximately 100 persons who own property in the flood zone, 87 property owners were interviewed regarding their willingness to sell their land. Approximately 50 per cent of them would consider selling at least part of their holdings if a program was implemented for this purpose. The individuals in this category did not appear to be identifiable in general terms by a characteristic such as area of land, age, or main occupation. It is of interest, however, that 40 per cent of those willing to sell wished to maintain farming operations on a lease basis.

Other observations regarding the characteristics of persons in the flood zone are discussed in the following pages.

The owner of less than 100 acres was the most desirous of retaining land in the area. These people are generally engaged in occupations other than farming. In this context, mink ranching is not included in the definition of farming. Otherwise, there did not appear to be any relationship between willingness to sell and size of holding. Furthermore, there did not appear to be any relationship between the proportion of land in the flood zone and willingness to sell. It may be concluded, therefore, that the threat of flooding by the lake was not a major factor in making the decision of whether or not to sell. Other factors which may have a greater influence on this decision are the threat of flooding from other causes, the difficulty of earning a satisfactory living at the present vocation and the age of the landowner.

The following scatter diagrams show the property owners by size of holding and percentage of land in the flood zone.

FIGURE II

PERCENTAGE OF PROPERTY IN FLOOD ZONE BY SIZE OF HOLDING

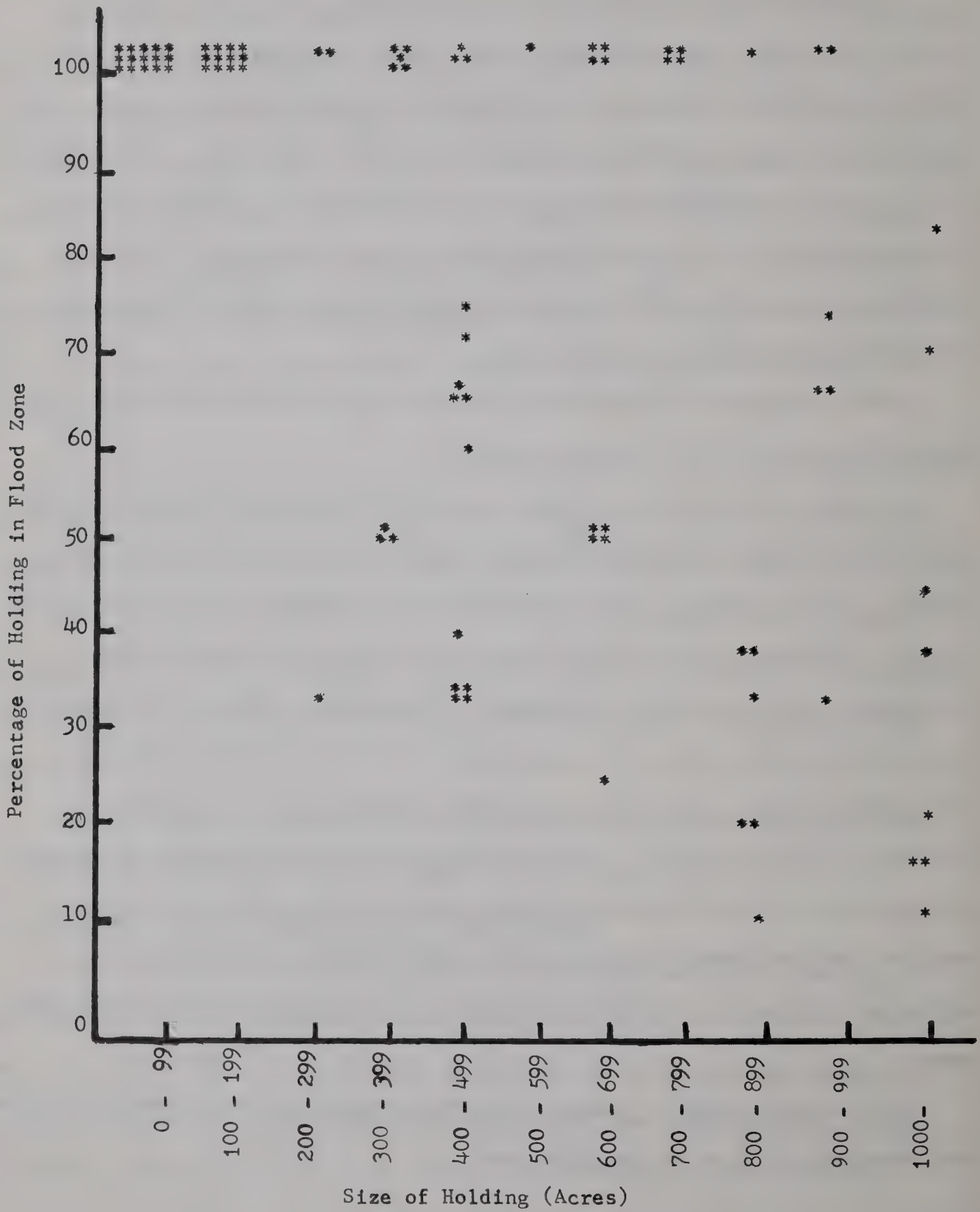
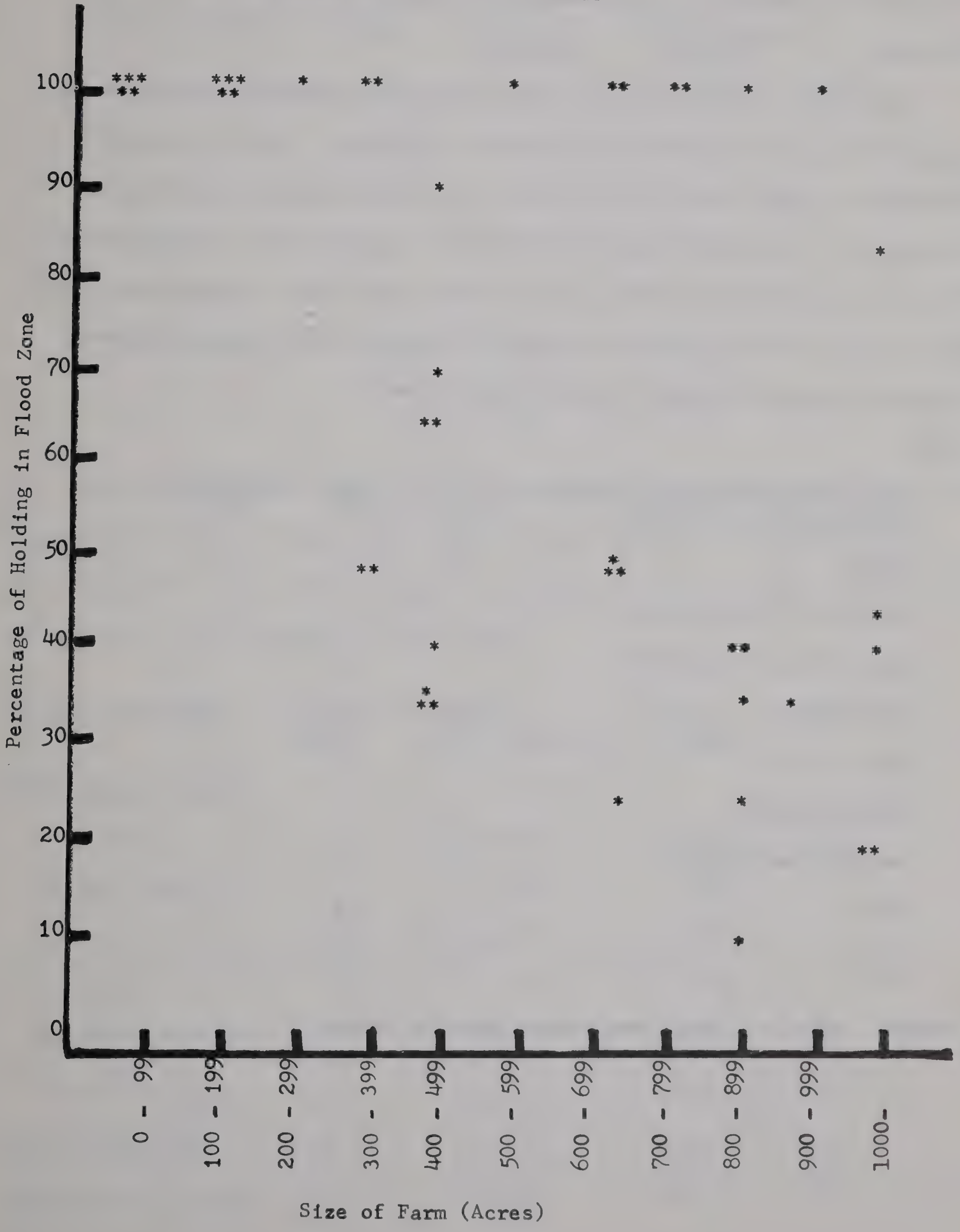


FIGURE III

NUMBER OF PROPERTY OWNERS WILLING TO SELL ACCORDING TO PROPORTION OF LAND IN FLOOD ZONE AND SIZE OF FARM



Of the 17 occupations in which landowners are engaged within the flood area, farming ranks first with mink ranching second. The main occupation is defined as that from which the major source of revenue is obtained.

Landowners receiving most of their income from farming totalled 44 or approximately 50 per cent of all located in the area. Twenty landowners received no income from their property and relied completely on non-farm employment. A total of 23 part-time farmers received most of their income from non-farm sources although they did work their land to some extent. The major source of the landowner's income by occupation and their intentions regarding the sale of their land is shown below.

TABLE

Main Source of Income According to Occupation or Industry	Total	Will Sell	Will Not Sell
Farmer	44	24	20
Technical & Professional	3	2	1
Trap, Guide, Fire Control	2	1	1
Mink Rancher	9	1	8
Construction	6	3	3
Transportation	6	2	4
Semi-Skilled Worker	5	3	2
Other	12	8	4
Total	87	44	43

Source: Survey by Rural Development Research Branch.

The age of the owner did not appear to be related to the willingness to sell, as indicated by the table below:

Age of Owner	Total	Willing To Sell	Not Willing To Sell
Under 36	12	6	6
36 - 45	19	12	7
46 - 55	19	10	9
56 - 65	24	10	14
Over 65	8	5	3
Not Stated	5	1	4
Total	87	44	43

Respondents who indicated a willingness to sell were requested to indicate their future plans, if any. The following table shows that the majority of those who wish to sell would remain in the area as tenants or as owner-tenants if they sold only a portion of their land.

Owner's Intentions	No. of Farms	Acres in Flood Zone (1)	Total Acreage	%
Willingness to Sell				
Rent Back	17	6,069	12,401	27
Change Vocations	9	3,883	5,163	11
Relocate Farms	7	1,867	2,856	6
Retire	1	318	318	1
No Definite Plans	10	2,078	4,276	10
Total Willing to Sell	44	14,215	25,014	55
Not Willing to Sell	43	13,853	20,540	45
Total Owners in Study	87	28,068	45,554	100

(1) The number of patented acres in the flood zone as shown above exceeds the number estimated by Water Resources Division. This is because portions of quarters lying above the flood zone would have to be purchased as a unit, as it would not be feasible to sub-divide quarter sections.

COST OF ALTERNATIVE III

Involved in this alternative are the costs of purchasing land which owners indicated a willingness to sell, relocation and training costs, and perhaps annuities for those in the older age brackets who wish to retire. The acreage of land in this alternative is the total owned by the operator, regardless of whether or not the land is in the flood zone. In otherwords, if one quarter is in the flood zone and three quarters are on high land, the cost of the total section is included as shown below. The cost of relocating a family was assumed to be one thousand dollars and the cost of retraining, three thousand dollars per person.

COST OF BUYING LAND (ALTERNATIVE III)

Acres Below 1,897 feet.	5,949 acres		
Cost of Land @ $8.32 per acre		$ 49,496	
Acres Above 1,897 feet:			
To 1,902 feet	8,266 acres		
Above Flood Zone	10,799 acres		
Total	19,065 acres		
Cost of Land @ $57.65 per acre		$1,099,097	
Total Cost of Lands			$1,148,593
Cost of Relocation - Maximum of 26 Families			$ 26,000
Cost of Retraining 9 Persons @ $3,000			$ 27,000
Total			$1,201,593
Annual Cost if Ammortized Over 100 Years at 5.65%			$ 68,428

Benefits, calculated in the same manner as in Alternative II, amount to an amortized value of $65,447.

4. Provision of Emergency Supplies of Fodder and Pasture

The fourth alternative is to provide assistance to ensure long term emergency supplies of fodder. Hay could be stored in sheds or silage could be maintained in trenches, pits or silos. Emergency pasture could be developed in the region to be used during periods of severe lake flooding. In addition to programs to supply additional quantities of fodder during emergencies, it would be possible to shift the livestock enterprise from predominantly a cow-calf program to a stocker or feeder plan.

The cost of erecting a hay shed or of excavating a silage pit would vary according to the size, location and availability of locally produced construction materials. A reasonable figure to use would be $1,500 per farm for approximately 40 farmers.

The size of a pasture required, based on 2 acres per animal, for 50 per cent of the present cattle population would be 2,450 acres. The development costs of clearing, disking, fencing and seeding to grass, based on $40 per acre, would total $98,000.

If the pasture was used only during periods of severe flooding, which is an impractical assumption, the benefits per acre would be $1.24. This calculation would involve estimating the value of pasture at $2 per head per month and considering the probability of flooding at 23.4 years out of 100.

- APPENDIX -

TABLE I

ACTUAL AND SIMULATED MAXIMUM ANNUAL LAKE LEVELS AND ACRES AFFECTED

Year	Lake Level Without Canal	Acres* Saturated	Lake Level With Canal	Acres* Saturated
1915	1,892.8	8,824	1,889.3	
1916	1,892.2	2,206	1,889.2	
1917	1,893.0	11,030	1,889.4	
1918	1,891.2		1,888.9	
1919	1,892.9	9,927	1,889.4	
1920	1,896.3	38,836	1,891.8	
1921	1,894.4	26,472	1,890.1	
1922	1,892.9	9,927	1,889.4	
1923	1,891.8		1,889.1	
1924	1,890.6		1,888.7	
1925	1,891.8		1,889.1	
1926	1,892.8	8,824	1,889.3	
1927	1,895.5	35,300	1,891.1	
1928	1,893.3	14,339	1,889.5	
1929	1,892.8	8,824	1,889.3	
1930	1,895.4	34,858	1,891.0	
1931	1,892.8	8,824	1,889.3	
1932	1,892.7		1,889.6	
1933	1,892.4	4,412	1,889.2	
1934	1,895.3	34,416	1,890.9	
1935	1,898.9	50,328	1,895.0	33,090

1936	1,895.9	37,068	1,891.5
1937	1,893.7	18,751	1,889.7
1938	1,890.6		1,888.7
1939	1,888.6		1,888.1
1940	1,888.8		1,888.2
1941	1,890.9		1,888.8
1942	1,890.7		1,888.8
1943	1,890.1		1,888.6
1944	1,889.2		1,888.4
1945	1,889.3		1,888.4
1946	1,889.0		1,888.3
1947	1,890.5		1,888.7
1948	1,892.7	7,721	1,889.3
1949	1,890.9		1,888.8
1950	1,891.5		1,889.0
1951	1,891.9		1,889.1
1952	1,892.5	5,515	1,889.3
1953	1,892.5	5,515	1,889.2
1954	1,894.3	25,369	1,890.1
1955	1,894.7	29,781	1,890.4
1956	1,894.5	27,757	1,890.2
1957	1,894.0	22,060	1,889.9
1958	1,894.3	25,369	1,890.1
1959	1,891.1		1,888.9
1960	1,891.1		1,888.9
1961	1,891.7		1,889.0

1962	1,893.9	20,957	1,889.8	
1963	1,894.9	31,987	1,890.5	
1964	1,895.3	34,416	1,890.9	
1965	1,896.9	41,488	1,892.5	5,515
1966	1,893.5	16,545	1,889.6	
Average Annual Maximum	1,892.7		1,889.6	+ Average Elevation Assumed

* Lake Level + 2 Feet.

Excerpt of a letter from:

W. L. Nisbet
Solicitor
Department of Lands & Forests

If the recession of the water is affected by artificial works, a presumption arises to the effect that the recession has not been gradual or imperceptible. However, even if artificial works are involved, the doctrine of accretion may apply if the exposure of land has occurred by the gradual, imperceptible and permanent recession of the water.

The law of accretion is relatively clear. Great difficulty arises in attempting to apply the law to a given state of facts. It is often difficult to obtain evidence to establish the manner in which water has receded, and if any artificial works are involved or can reasonably be expected to have affected the exposure of land, the likely conclusion would be that the doctrine of accretion does not apply and the exposed land would be claimed by the Crown in right of the Province.

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